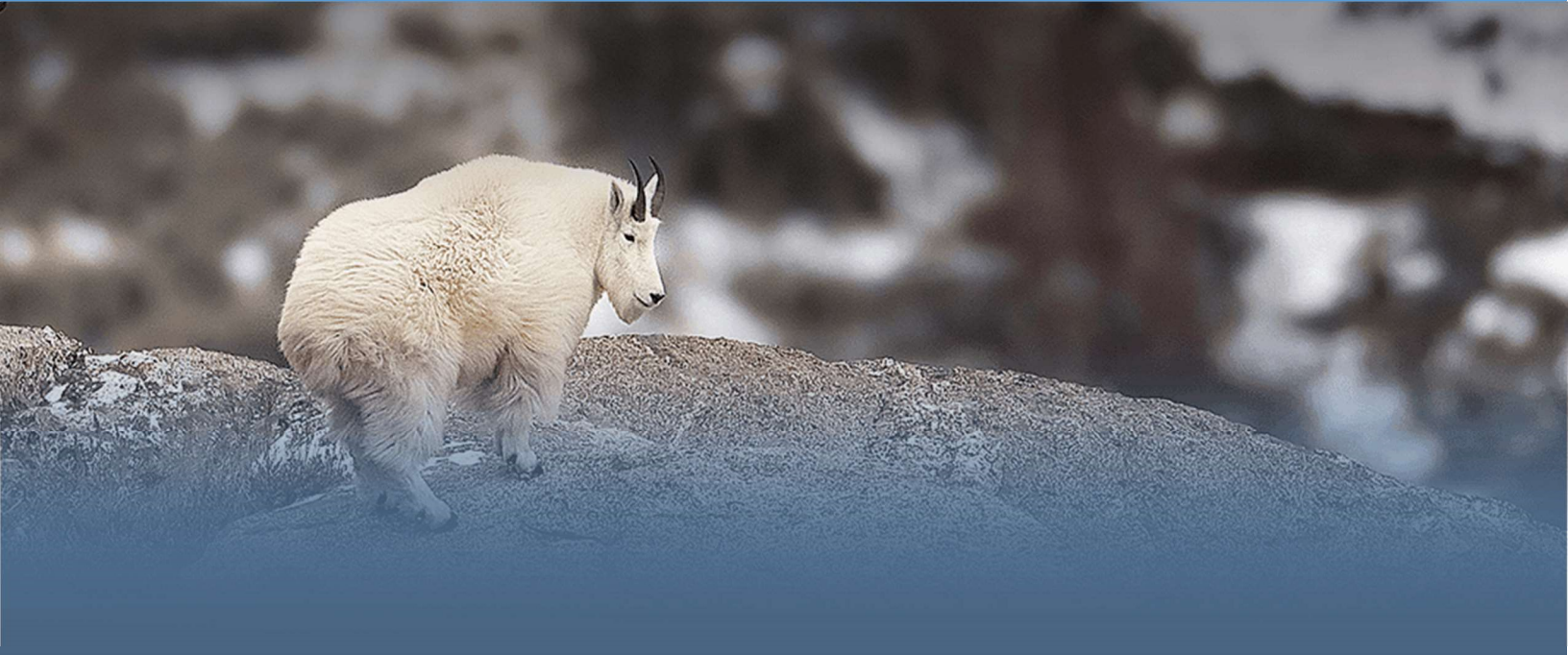

The Future of Hunting and Fishing

Conducted for
The Council to Advance Hunting
and the Shooting Sports

by
Chase & Chase Consulting

2017

COUNCIL
TO ADVANCE
HUNTING AND
THE SHOOTING
SPORTS

Recruit | Retain | Reactivate

ACKNOWLEDGEMENTS:

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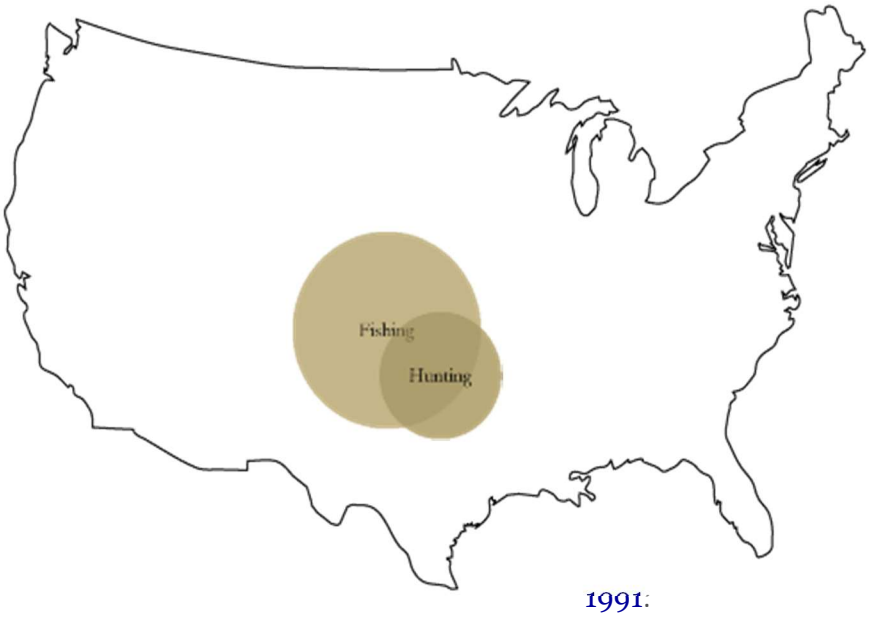
"Mountain Goat" Nevada Department of Wildlife
http://www.ndow.org/uploadedImages/ndoworg/Content/Nevada_Wildlife/_Meta/subpage_slide_nevada_wildlife.png

Executive Summary

North American Model

The North American Model of Wildlife Conservation has been, and continues to be, the envy of the world. The success of the model stems from a user-pay, all-benefit funding system, supplied by fees from hunting and fishing licenses and an excise tax on equipment used to participate in hunting, shooting, boating, and fishing. The financial virility, and therefore the effectiveness of the model, will deteriorate should participation in hunting and fishing wane.



Waning Participation

In 1991, 40 million people hunted and fished. After 26 years, 39.6 million people hunted and fished, a minimal decrease. However, at the same time, the US population grew 30%. If the US population were proportional to the land mass depicted here, the Venn diagrams would represent the percentage of citizens who hunt (1.2%), fish (8.6%), or participate in both (2.4%) in 2016.

Shrinking Societal Influence

Today, there are 400,000 fewer hunters and anglers than in 1991. The US has grown by 76 million people in the same timeframe. In 1991, 1 in 6.3 people would have been a hunter and/or an angler; in 2016 that figure drops to only 1 in 8.2 people. This represents a significant change in the US complexion, and results in fewer people contributing to wildlife conservation, with more people benefiting from it.

1991:

2016:

Decline of Hunting and Fishing Participation

In national sales, declines in hunting and fishing licenses are anticipated. Once standardized as a percentage of population, the declines were more evident. Understanding the factors that contribute to this decline is paramount to addressing the concerns of future funding for conservation.

We found age effects increase participation with youth (12-17), presumably due to youth hunts, less expensive youth hunting licenses, and other incentives provided by the recruitment efforts of wildlife agencies. Following this period, there is a reduction of participation during college years and adult establishment period (18-27). Once adults are established, have disposable income, and hold jobs that afford the time for recreation, an increase in hunting and fishing occurs. As adults reach their early 70's, the physicality of hunting often precludes participation. Similarly, fishing generally shows attrition as an adult reaches their mid-70s.

Period effects can be observed associated with the U.S. stock market contraction in 2008 associated with the rapid decline in home values, which affected the sales of hunting and fishing licenses first negatively leading up to the contraction and then positively during the recovery. In general, externalities, such as this market contraction, affect fishing more so than hunting, presumably because hunting is more central to a person's lifestyle and more resources are already invested in the sport. As individual states change their marketing and license structures they may show gains and losses in their respective licenses.

Cohort effects are clearly the strongest driver in hunting and fishing participation. Individuals born during the years 1960 to 1980 are the most likely to hunt and fish. These findings definitively demonstrate hunting and fishing are not tied to a specific life stage; rather, there is a twenty-year cohort of hunters/anglers moving through different life stages that have experienced high participation rates throughout their lives.

> Hunting and Fishing participation is not dictated by age, but by the generation that a person belongs to. The opportunity before the conservation community is to connect other generations with hunting, fishing, and other outdoor recreation.

Conclusion

This research suggests there is a significant decline in hunting and angling participation. Reductions in conservation revenue may begin as early as 2024, and by 2032 state wildlife agencies and other conservation organizations may face great challenges in revenue shortages, loss of political capital, and shrinking social relevancy.

Background

There is a clear and present need for research that scientifically forecasts the future of hunting and fishing participation and soundly conveys how declines are going to affect wildlife conservation agencies. Nearly all executive-level administrators and decision makers in state, federal and NGO organizations intuitively understand that hunting and angling is declining. Those administrators also understand the implied threat to conservation, as nearly 60% of agency revenue is dependent upon the discretionary spending of hunters and anglers (AFWA & AGFD, 2017).

However, what conservation leaders may not understand is the imminence and immediacy of the timeline of this projected decline. Knowledge regarding the attrition of hunters and anglers is largely subjective and based upon anecdotal evidence from experts familiar with the historical trends. The issue that arises from this subjective approach is that it does not convey urgency, as many leaders erroneously believe the decline will affect the next generation of leadership. Unfortunately, this passive approach may hamper proactive ideas regarding recruitment, retention, and reactivation of hunters and anglers and finding alternative conservation funding sources.

The present study is a repeat of a national study conducted in 2011 by the Arizona Game and Fish Department, endorsed by the Organization of Wildlife Planners and The Wildlife Society's Human Dimensions Working Group (Chase, 2012). In that 2011 study, it was shown that there is a cohort of individuals that is aging toward a point where they will no longer be able to participate in hunting and angling due to the physicality inherent in the sports. That study indicated the lead edge of the cohort will begin to attrite from hunting and fishing beginning about 2024, after which point the attrition rate will begin to steepen. The 2011 data was based on state wildlife agency license databases from 6 pilot states and 16 additional states that joined the project later. Although the predictions from the preliminary study were accurate using the data from the time, the accuracy of any predictions are contingent upon the duration of the predictive data, and upon the temporal proximity of the predicted year and the current year. As we are now closer to the predicted year, and more data are available, the 2011 study needed to be replicated to ensure that management actions based upon that data are still reasonable.

Methods

To illustrate the patterns of hunting and fishing license sale declines, we conducted an age-period-cohort (APC) analysis on hunting and fishing license sales in the United States. This method is different from surveys, panel studies, or focus groups that rely on self-reporting of behaviors, as these methods of data collection are subject to a number of biases. The APC analysis of license sales is reliant upon the actual behaviors such that there are no errors derived from respondent reporting. Many such human dimensions studies confirm the findings contained herein.

Age, period, and cohort effects are extremely difficult to disentangle because at any instant in time any two of the three variables are perfectly linear (e.g., a person who turns 39 in 2017 will always have been born in 1978, therefore no variability is available for prediction in the model). Therefore, data collected across time are necessary for differentiating age, period, and cohort effects. An understanding of each of these three effects is crucial to comprehending the remainder of this report, therefore the following definitions should be considered:

> Age effects manifest by altered behaviors at specific ages, regardless of what year in time it is and what is occurring during that year. This effect is often influenced by the biological factors of the participant. An example of age effect is that families are usually started in a person's 20's or 30's, regardless of what year in time it is (period) or what year of birth the prospective parent is in (cohort).
>
> Period effects occur when a specific year in time shows a change in behaviors across all age groups simultaneously within the same year. This effect is often influenced by social factors contemporary to the year effected. An example of period effects is the how Americans of all ages (age and cohort) adjusted their spending and investing behavior in 1999 due to the "DotCom" boom and subsequent bust in 2000.
>
> Cohort effects manifest when people of the same birth year who are consistently higher or lower in their participation. This is also known as generational effects. This effect is often influenced by societal factors occurring during the formative years of the participant. An example of cohort effect is that because of events such as Martin Luther King Jr.'s march on Washington, troops in Vietnam, and the Civil Rights Act of 1964, which occurred during Baby Boomer's formative years, Boomers tend to be more socially active throughout their lives (age) regardless of contemporary circumstances (period).

Misunderstanding these effects can impede conservation leadership's ability to effectively address the loss of hunters and anglers. As recently as the early 2000's, it was believed that hunting and angling were, and always would be, sports for the middle-aged. This conjecture gave rise to the assumption that Gen X and Millennials would eventually replace the Silent and the Baby Boomer generations in license purchases. However, we now know this is not the case; Millennials in particular are not adopting hunting and angling into their outdoor recreation repertoire at rates that can sustain conservation.

Millennials in particular are not adopting hunting and angling into their outdoor recreation repertoire at rates that can sustain conservation.

Participating States

There were many states that showed interest in the project, but 26 ultimately participated:

Alaska Department of Natural Resources
California Department of Fish and Game
Colorado Department of Natural Resources
Florida Fish and Wildlife Conservation Commission
Georgia Department of Natural Resources
Idaho Fish and Game
Indiana Department of Natural Resources
Iowa Department of Natural Resources
Kansas Department of Wildlife, Parks and Tourism
Kentucky Department of Fish and Wildlife Resources
Massachusetts Department of Fish and Game
Montana Fish, Wildlife & Parks
Nebraska Game and Parks
Nevada Department of Wildlife
New Mexico Department of Game & Fish
NYDEC-Division of Fish and Wildlife
Oklahoma Department of Wildlife Conservation
Oregon Department of Fish and Wildlife
Pennsylvania Game Commission
South Dakota Game, Fish, and Parks
Texas Parks and Wildlife Department
Utah Department of Natural Resources
Virginia Department of Game and Inland Fisheries
West Virginia Division of Natural Resources
Wisconsin Department of Natural Resources
Wyoming Game and Fish Department

The participating states account for 52% of the total number of states and 56.3% of the paid licenses in the nation (USFWS, 2017). We consider these states to be representative of the pattern that exists in all 50 states. We assert this representativeness for the following reasons:

1. Each state, with few exceptions, show consistent trends
2. Societal factors such as modernization, thought to be the root cause of the decline of hunting and fishing participation, transcend state borders
3. Although this research was an opt-in participation for each state, there was no systematic selection that would suggest a biased sample of states
4. The patterns of this study strongly reflect the findings of the previous study, conducted in 2012.

Data cleaning

Nearly every participating state wildlife agency warehouses their data in a different format, using various data conventions. Over half of the project resources were spent trying to move license sales data into a normalized, uniform or standard file format, data structure, and congruent naming conventions. For example, some states stored data as Access files, others saved the data in comma delimited format, while still others sent the information in text files or .csv files. Additionally, some states stored their data in one file for all years, while others saved the data for each year in separate files. Nearly every state stored each variable in different formats. These factors are surmountable, but each must be addressed to resolve data analysis across states. If state agencies desire more research to be conducted at the national level, state wildlife agencies may consider standardizing the way they collect, synthesize and warehouse data.

Combination licenses pose a unique challenge because they convey both hunting and fishing privileges. However because we could not differentiate intention of the license purchase, and the fact that many agencies treat these licenses in a separate manner, we chose to treat them as separate licenses. Therefore we grouped licenses into hunting, fishing, and combination licenses for both residents and nonresidents.

Data analysis

Data were prepared using Microsoft's Excel and SPSS 24 statistical software. Data were analyzed using the R statistical package version 3.2.5 (Very, Very Secure Dishes) as well as SPSS 24. The "APC," "readxl," and "EPI" packages were integral in the analyses of these data. Data analyses were conducted on six license groupings: Hunting, Fishing, and Combination Hunting and Fishing licenses for both residents and nonresidents. Stamps such as duck stamps, upland game stamps, two-pole stamps, duplicates/ reprints, endorsements for specific geographic areas, or species-specific privileges were not included in the analysis. This measure was taken so as to not double count an individual who purchased a license and stamps within a specific state database. Tags or permits were not included unless they were part of the main license or package.

For some states, the age at the time of purchase was provided within the dataset, for states that did not provide this information, the age was calculated by subtracting the date of birth from the purchase date, and then rounded to the nearest integer. Although this introduces a minor amount of error, it has a negligible effect on the analysis.

Some states did not sell a general hunting license, but sold species-specific licenses that imparted the privilege to hunt as part that license. In these cases, licenses were de-duplicated by a unique identifier so as to not double count individuals purchasing multiple species hunting privileges. For example, in Wisconsin, it is assumed that a large percent of hunters buy deer licenses (approximately 97%) so this is reasonably used as an approximation of Wisconsin hunters (Winkler & Warnke, 2013) However,

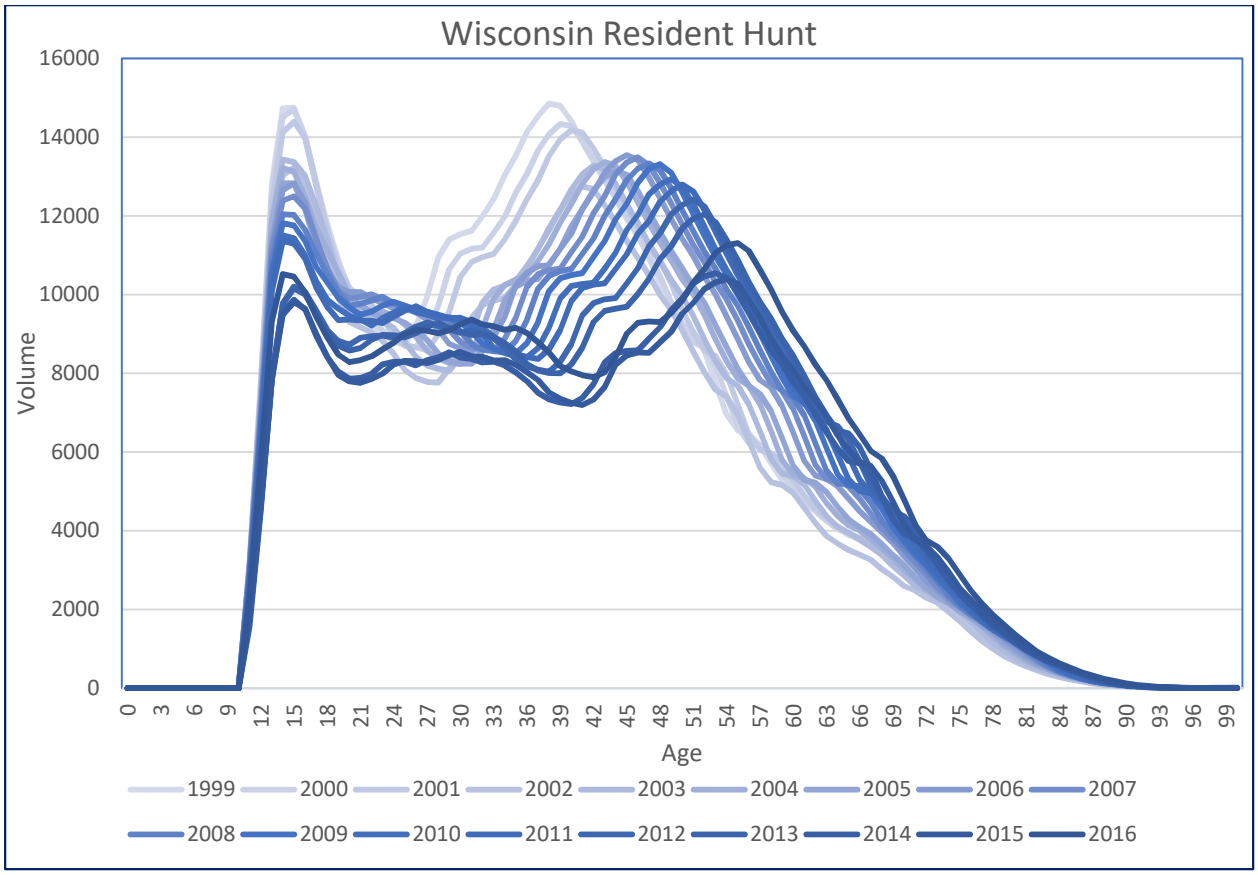
the approach used in this study included all licenses for all species and were de-duplicated using a unique identifier to include all hunters. Performing the analysis on all hunters is advantageous, particularly in states that may not have a species that is so ubiquitously used as Wisconsin deer. It is important to note that although hunters were de-duplicated within individual states' databases, was impossible to remove individuals that appear in multiple state license databases. This should be a consideration for interstate coordination for have a unique identifier across all states to have better tracking across state lines.

Data analyses were completed on actual data, but, for display purposes, a smoothing factor was applied. The smoothing factor was calculated for each age, an average of the age before, the actual age, and the age after. The smoothing factor does not influence the analyses, but reduces the influence of outliers in visualization.

The influence of the aforementioned factors, and the strength of those factors, was determined using Akaike's Information Criterion (AIC) table, generated from the "APC" package. The full model (containing age, period, and cohort) was compared to reduced models (containing only subsets of those variables), and the resultant change in AIC was used to determine the model of best fit. If a variable was taken out of the model and the AIC increased dramatically, that factor should be considered highly influential. Conversely, if a factor was taken out and the AIC changed very little that is evidence the factor had little influence on the model. Through this process it was determined that cohort effects are clearly the strongest driver affecting hunting and fishing participation.

APC illustration: Wisconsin hunters

The depiction below shows the resident hunting license sales for Wisconsin since 1999. The horizontal axis represents licensee ages ranging from 0 to 100. The vertical axis indicates the volume of licenses sold, beginning at zero and extending to various extents, depending on the popularity of the license being depicted. The lines represent different license years, darker lines representing more recent years and lighter lines representing earlier years. Each line represents a histogram or distribution of licenses sold during that year to each respective age. As such, the total area under each respective curve adds up to 100% of the license volume sold for that year. Comparing the total areas under the curve allow for a comparison of the volume of licenses sold from year to year. As an illustration, during 1999 (the lightest line) there were approximately 15,000 (the highest vertical point on that line) resident hunting licenses sold to 34 year olds (the corresponding horizontal coordinate). In comparison, in 2016 (darkest line) that same group (now 54 years of age) only purchased approximately 11,000 licenses (the vertical coordinate).



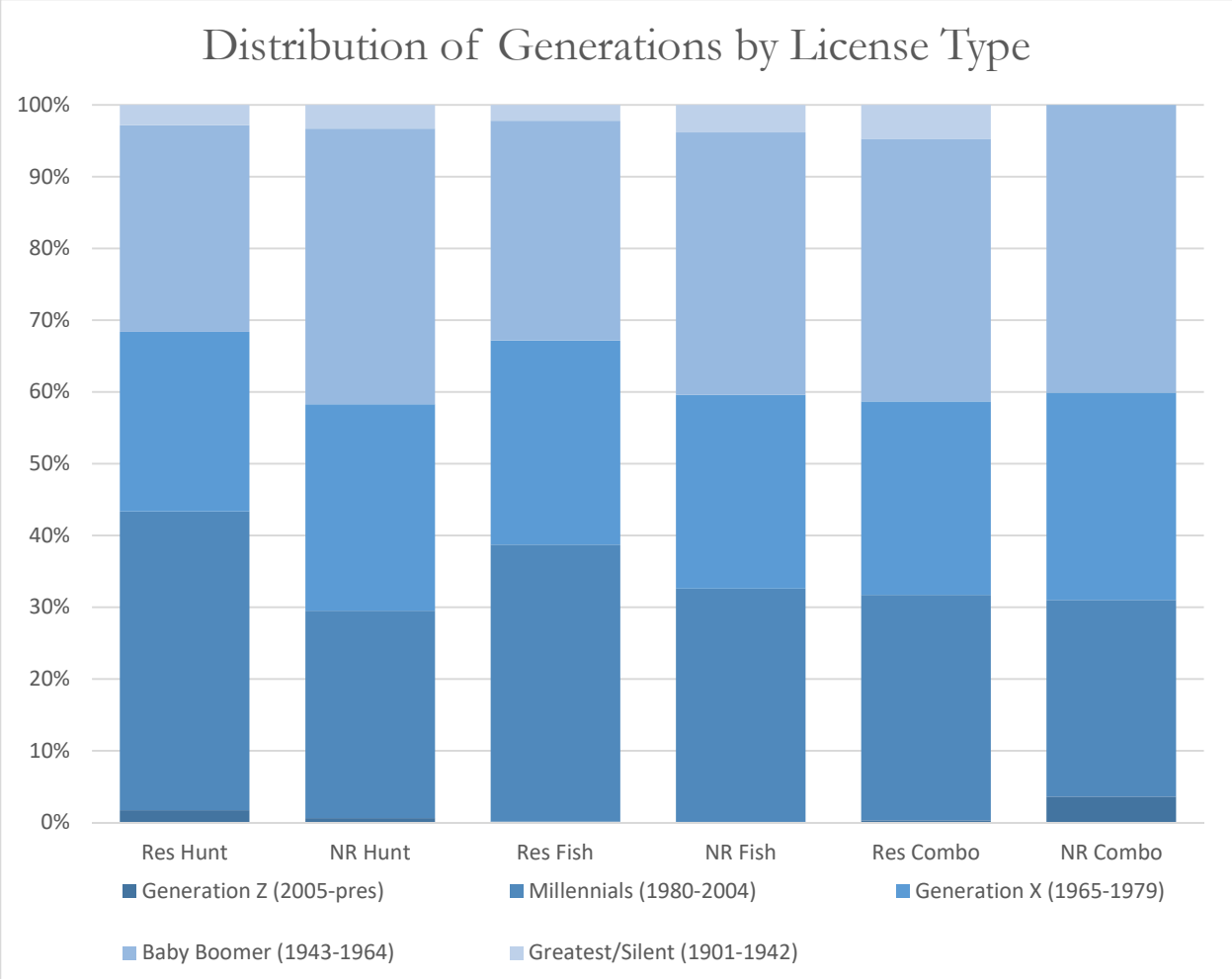
This graph also illustrates examples of age, period, and cohort effects in a model. Regardless of the year, there is an age effect, consistently peaking at about 15 years of age. Age effects usually are noticeable as vertical patterns on the graph. In Wisconsin in 2014 and 2015, there is a period effect manifested by an overall decline in licenses across all age groups, which then rebounds to expected levels in 2016. This is seen in this graph by the 2014 and 2015 years slumping behind the 2016 year. Period effects are usually noticeable when one line appears higher or lower than it "should" given the trends in other years. Finally, there is a cohort effect for people born in the early 1960's where they consistently hunt in larger proportions than other birth groups, regardless of the year in time being researched. Cohort effects are often noticeable diagonally across years, or as prominent peaks that appear to move through time on the graph.

Findings

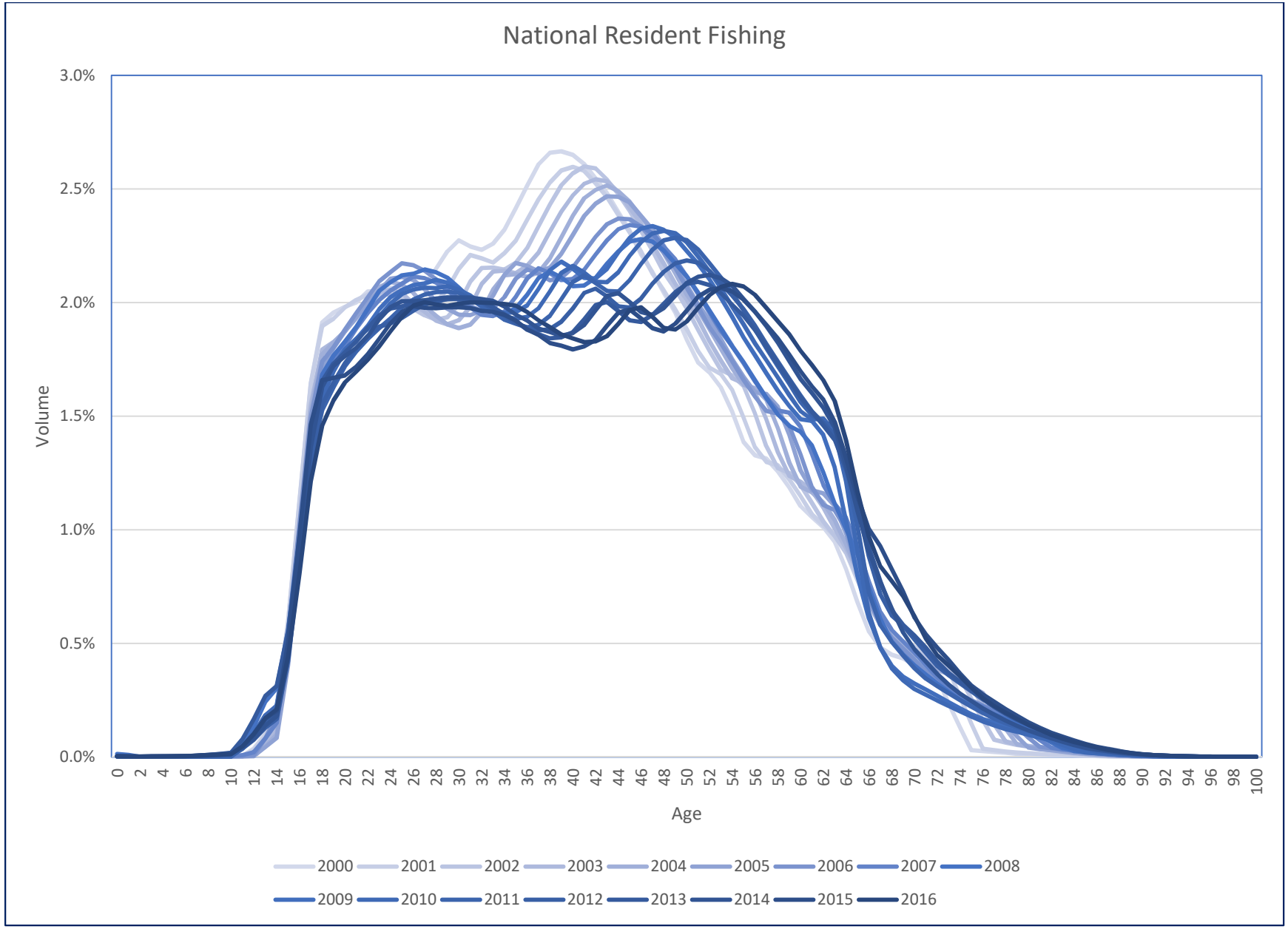
National level findings

Data from individual states can be found in Appendix A and should be referred to for greater understanding of aggregate data. However, the scope of this research is to provide insights into license sales patterns in a national context for hunting, fishing, and combination licenses for residents and nonresidents. In order to convey the greatest amount of information, state-level data is provided in raw numbers; that is the graphs depict the actual volumes of licenses sold on the vertical axis.

However, because each state has license data available for various license years, aggregated nationwide data depicted as raw numbers are misleading. National-level data graphed using raw numbers is more illustrative of data availability rather than actual declines or increases in license purchases. For this reason, data aggregated to represent trends at the nationwide level are displayed as percentages. Therefore, the total area under the line sum to 100% rather than the total sum of the licenses sold. This minor adjustment in display allows for an easier, clearer interpretation of national trends and allow for the inclusion of earlier license years. Further, for each graph, particularly when comparing the hunting, fishing, and combination license sales within a state, the vertical axis is on a different scale for each license. This does not impede interpretability because we are generally interested in the relative changes across time, though it may make licenses that have lower absolute volumes (in raw numbers) appear to be more volatile than had they been depicted on the same scale.



Data are from the national-level aggregation for the license year 2016


National Resident Fishing
3.0%
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2.0%
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0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100
Age
2000 2001 2002 2003 2004 2005 2006 2007 2008
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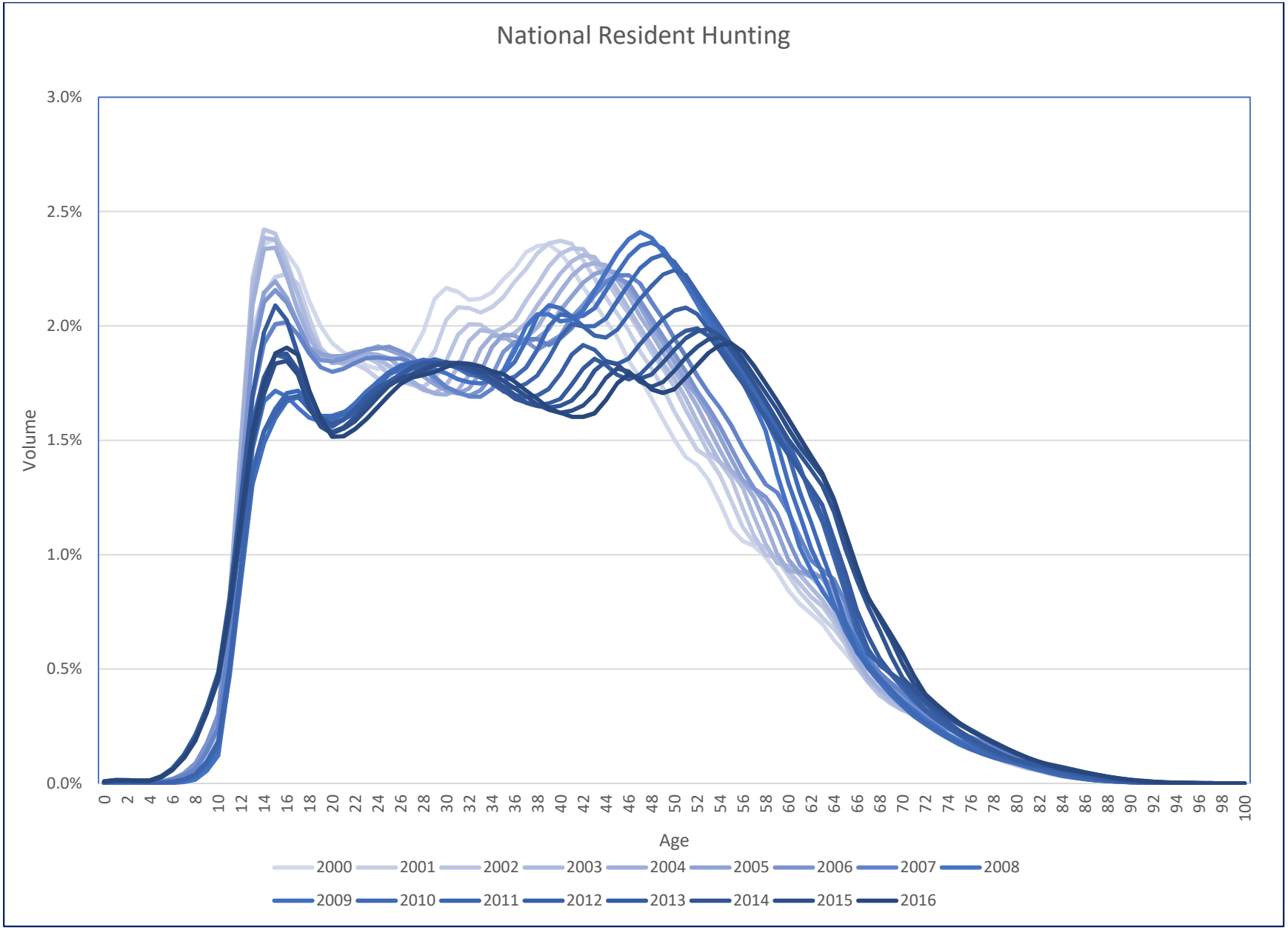
National Resident Hunting
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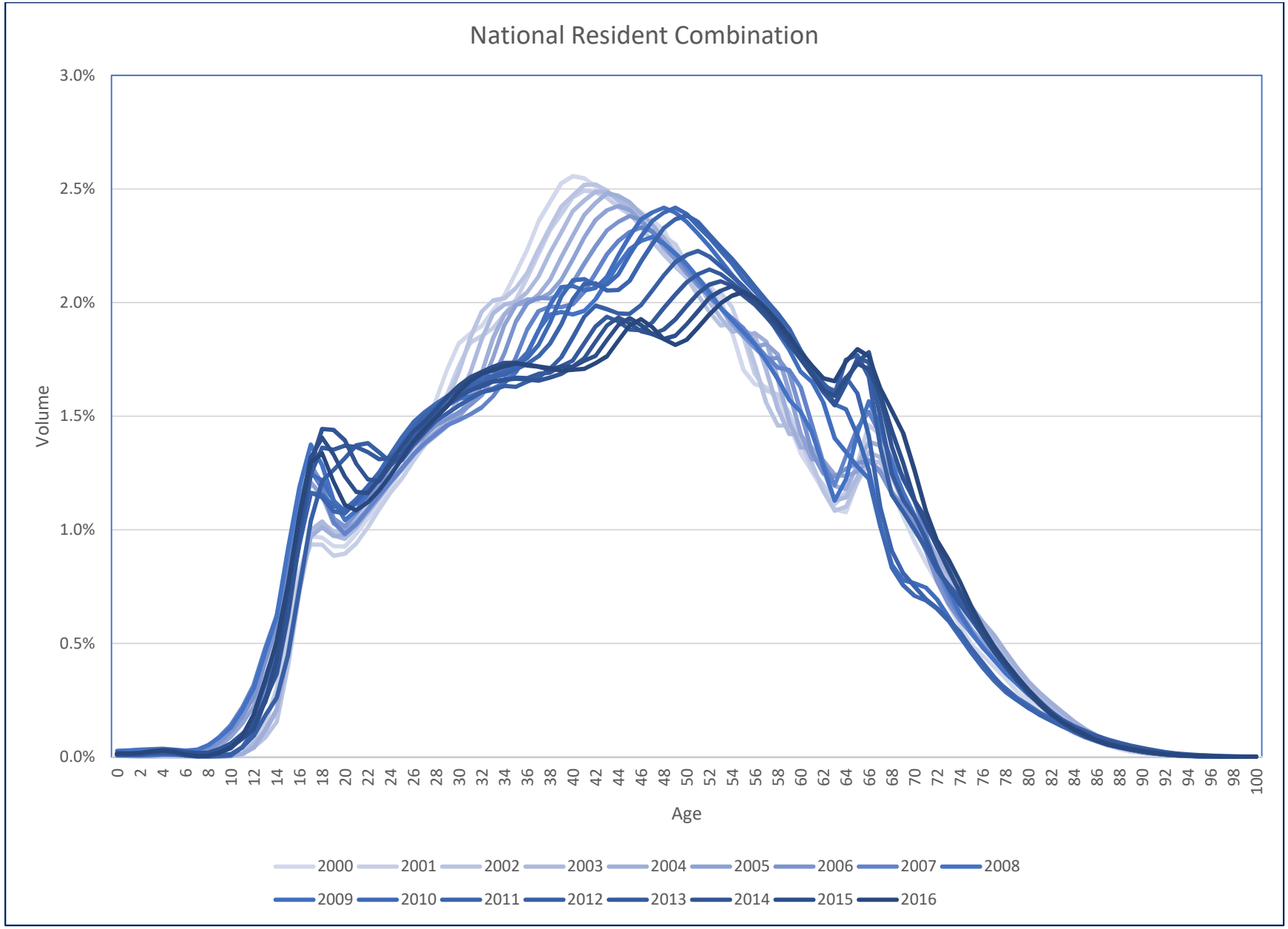
National Resident Combination
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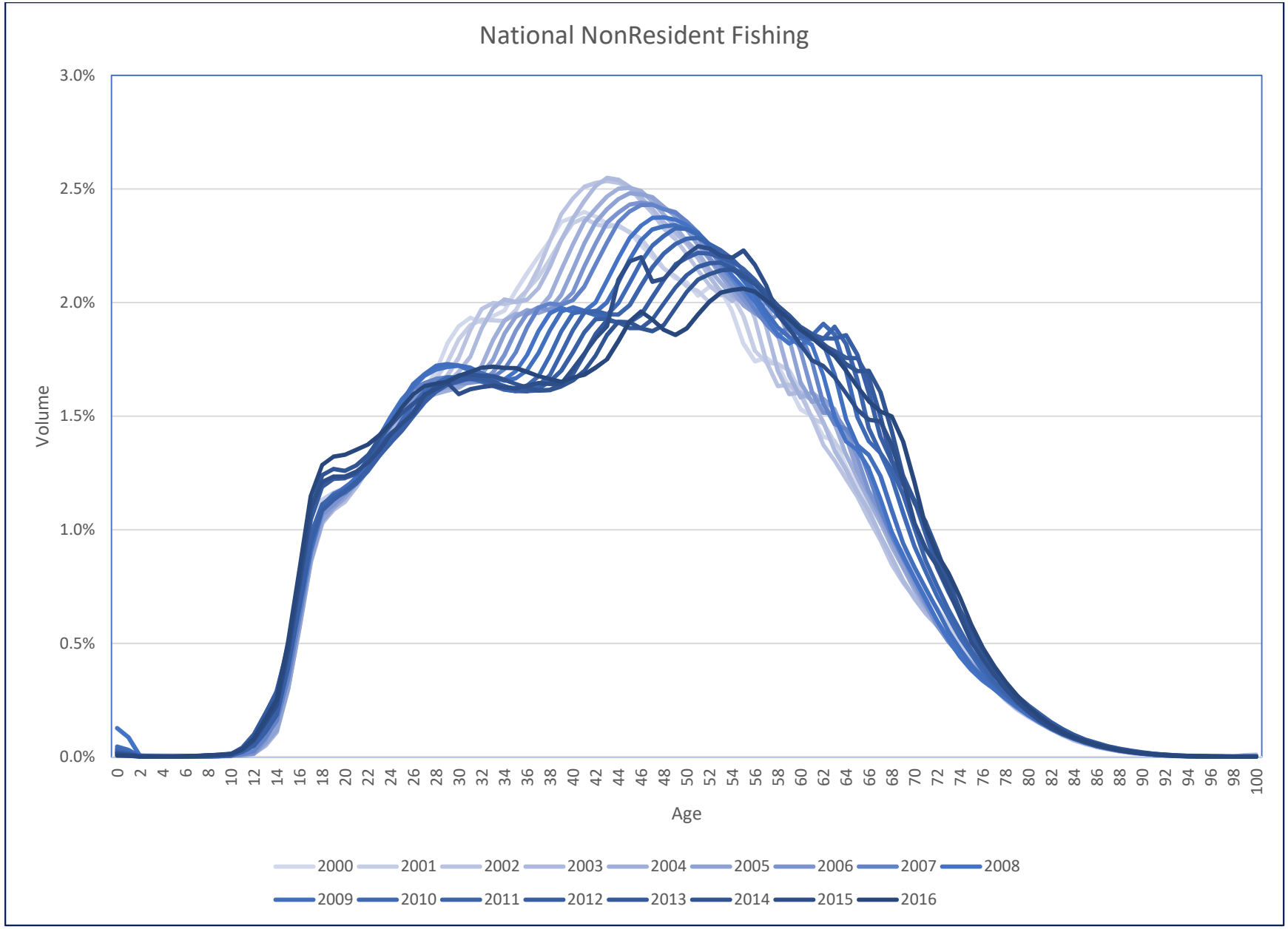
National NonResident Fishing
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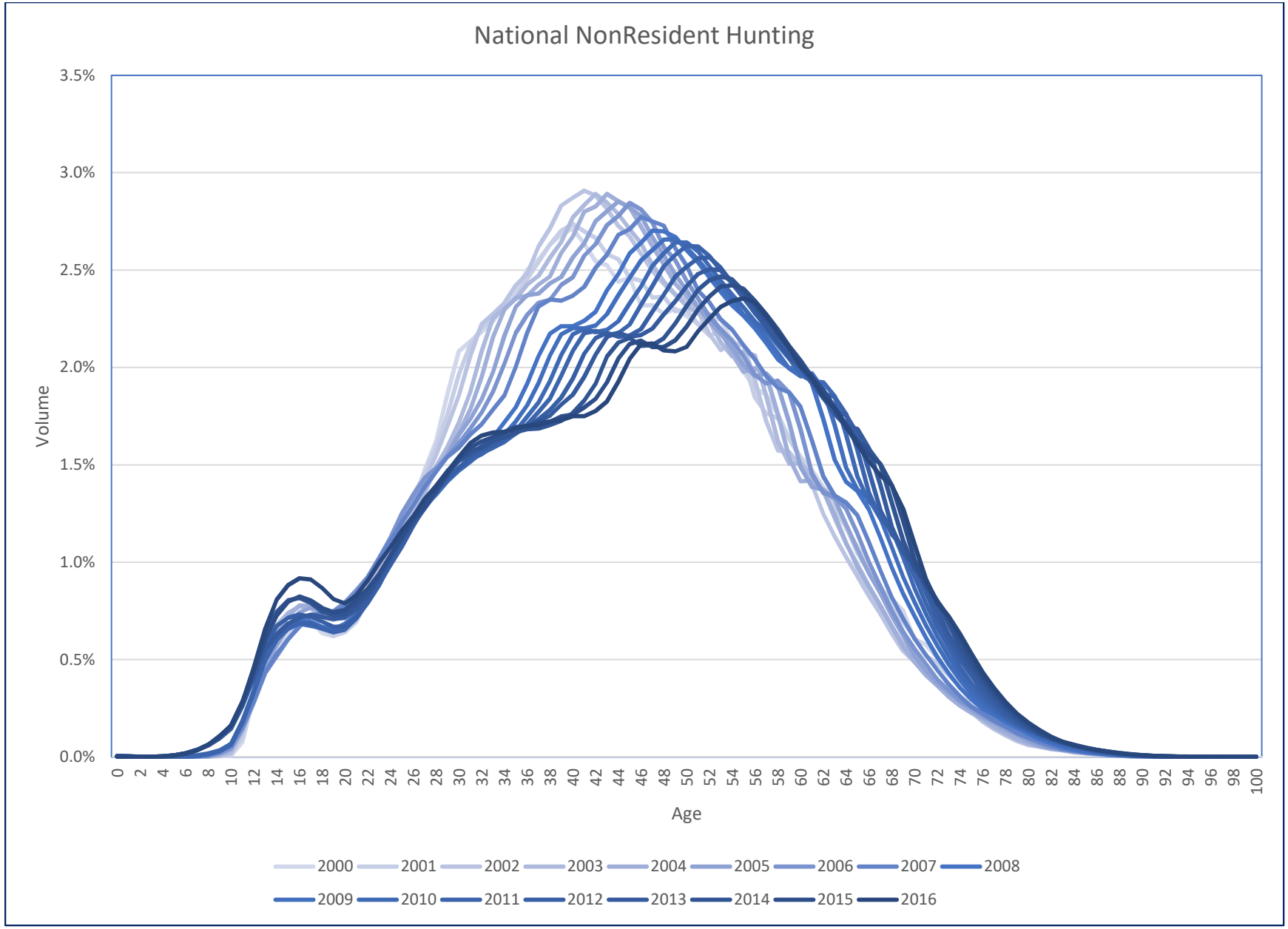
National NonResident Hunting
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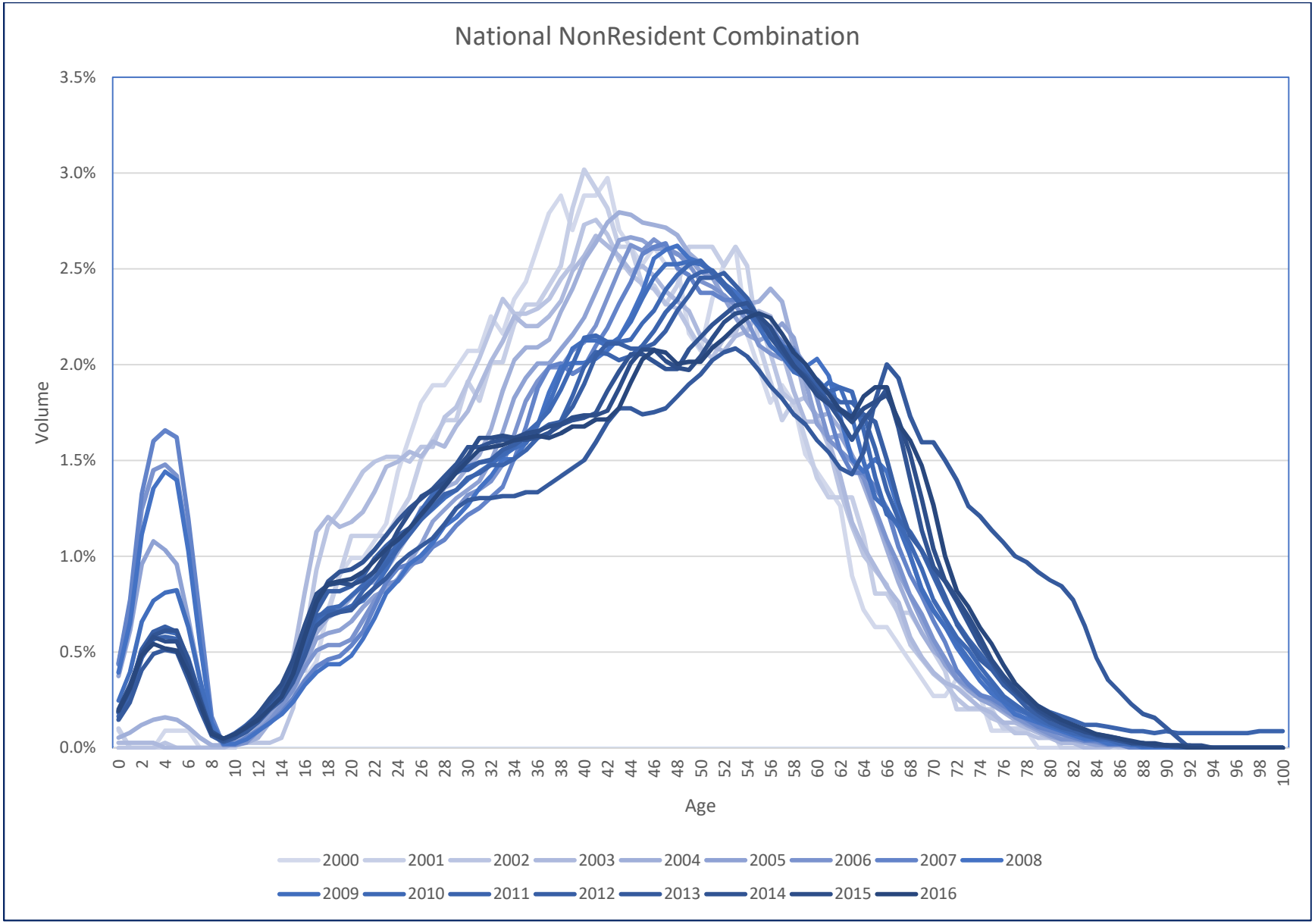
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Age
2000 2001 2002 2003 2004 2005 2006 2007 2008
2009 2010 2011 2012 2013 2014 2015 2016

Age, Period, and Cohort Effects

We found **age effects** decrease the amount of resident fishing license sales as anglers reach their late 60's. A similar, but more gradual, decline occurs for hunting licenses, though the decline seems to begin when hunters reach their early 60's. Another similar decline is noticeable for nonresident fishing and hunting licenses, beginning at comparable ages, but the decline is more gradual than the resident counterparts. This more gradual decline for nonresidents is presumably due to a health and wealth connection (a participant wealthy enough to hunt and fish in states where they are not residents would likely be healthier, which extends the age they are able to participate [Marmot & Bell, 2009]). Resident combination license sales have a similar age-out; however, it seems to occur later in time, closer to when a participant reaches their early 70's. This pattern with resident combination licenses may be because people who buy licenses that contain both hunting and fishing privileges are likely to have these activities more central to their lifestyle, and therefore they continue participation later in life. Further, there is an anomaly associated with retirement ages for the combination licenses. It appears that in the early 2000's there was a depression in combination license purchases just prior to the average time of a Baby Boomer's retirement, but after their retirement there was a bulge in combination license purchases. We hypothesize this anomaly may be caused by Baby Boomers having an interest in preserving points in draws, more states making the permit available, or it may be an artifact of policy changes.

License sales that include the hunting privilege increase during the teenage years, presumably due to youth hunts and less expensive youth hunting licenses. Following this period, there is a reduction of participation during college years and the adult establishment period.

There is another age effect for resident hunting, and, to a lesser extent, resident combination and nonresident hunting, during the teenage years. Participation in hunting temporarily increases with during the youth ages (12-17), possibly caused or enhanced by youth hunts and less expensive youth hunting licenses, however more research is needed. Following the youth ages, there is a reduction of participation during the traditional college years and early adulthood (18-27). Only time will tell if these individuals that hunted during their teens will return to hunting and fishing, but because the peak is not translating across time, we do not have evidence that this group is being retained at a rate commensurate to their participation during their teenage years.

Period effects can be seen at the nationwide level in that the U.S. stock market contraction due to the housing crash in 2008 immediately affected the sales of hunting

Cohort effects are clearly the strongest driver affecting hunting and fishing participation. These findings definitively demonstrate hunting and fishing are not tied to specific life stages.

licenses. A few years later, the market correction affected combination license buyers, presumably because these sportsmen and women are involved in both activities it took longer for economic conditions to alter their purchasing behavior. Period effects would not manifest as prominently at the national level because license structure changes, policy changes, drought, disease (such as CWD), and a number of other possible factors affecting license sales patterns at the state level are overshadowed by consistent license sales from other states.

Cohort effects are clearly the strongest demographic factor affecting hunting and fishing participation in the United States as indicated by the AIC. Individuals born during the years surrounding 1960 are the most likely to hunt and fish. These findings definitively demonstrate hunting and fishing are not tied to specific life stages; rather, there is a twenty-year cohort of hunters/anglers moving through different life stages that have experienced high hunting and fishing participation rates throughout their lives. This is reflected in the moving peak going through time, the peak of which occurs at age 40 in 2000 and at about 55 in 2016, the last available reliable data. A less prominent peak occurs with hunters and anglers who are about 10 years younger, who are aged approximately 30 in 2000 and 45 in 2016. This strong cohort effect is particularly influential when one considers that within the underlying U.S. population, from which hunters and anglers are a subset population, the Millennial generation surpassed the Baby Boomer generation in population size in 2016 (USCB, 2017).

Contributions of Age, Period, and Cohort Effects

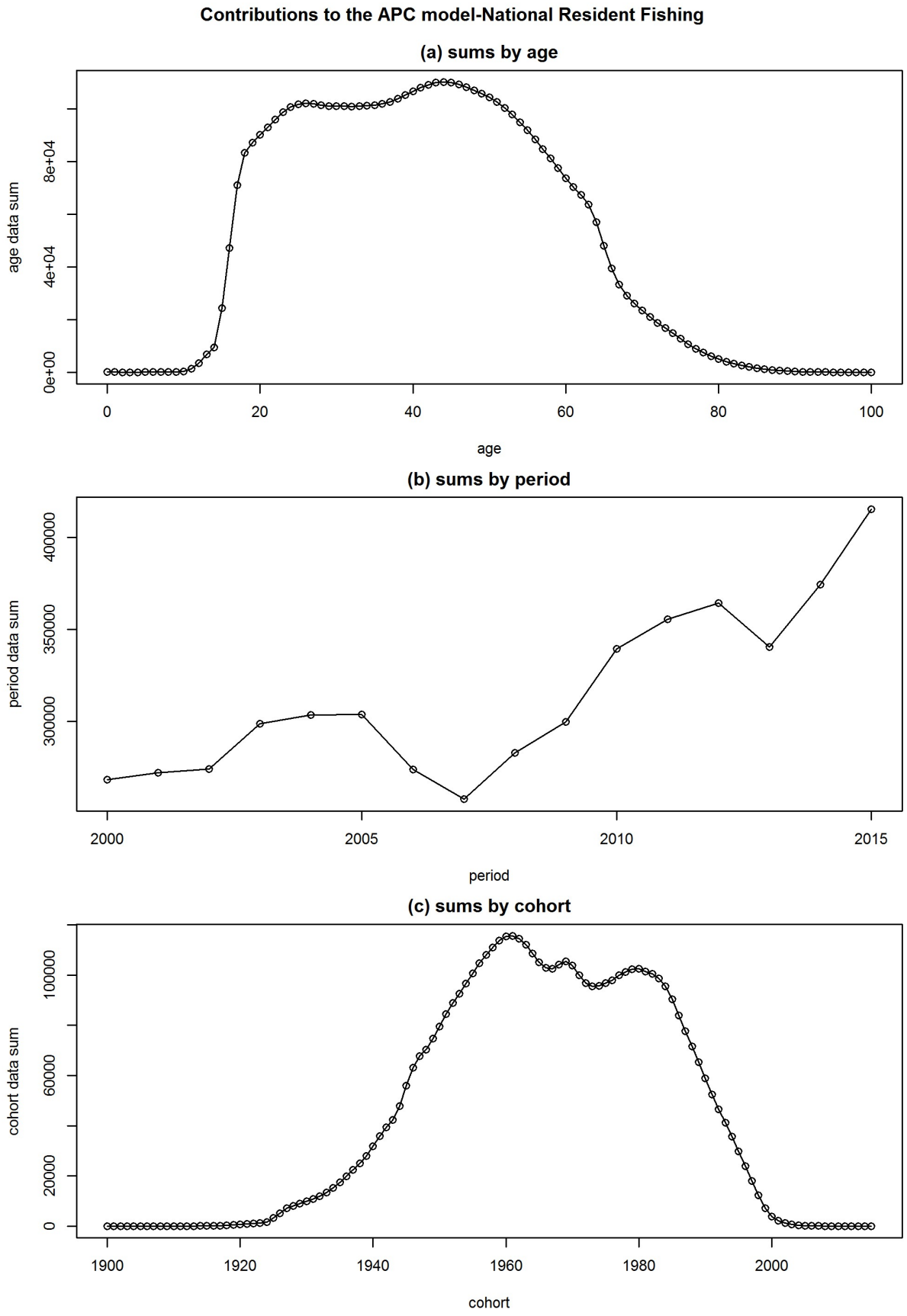
The following graphs examine age, period, and cohort individually, while holding the other two variables constant. Therefore, the volumes indicated on the Y-axis are the age, period, and cohort sums of the average of the participating states. These numbers hold little meaning as unqualified values other than to show the relative contribution of each factor.

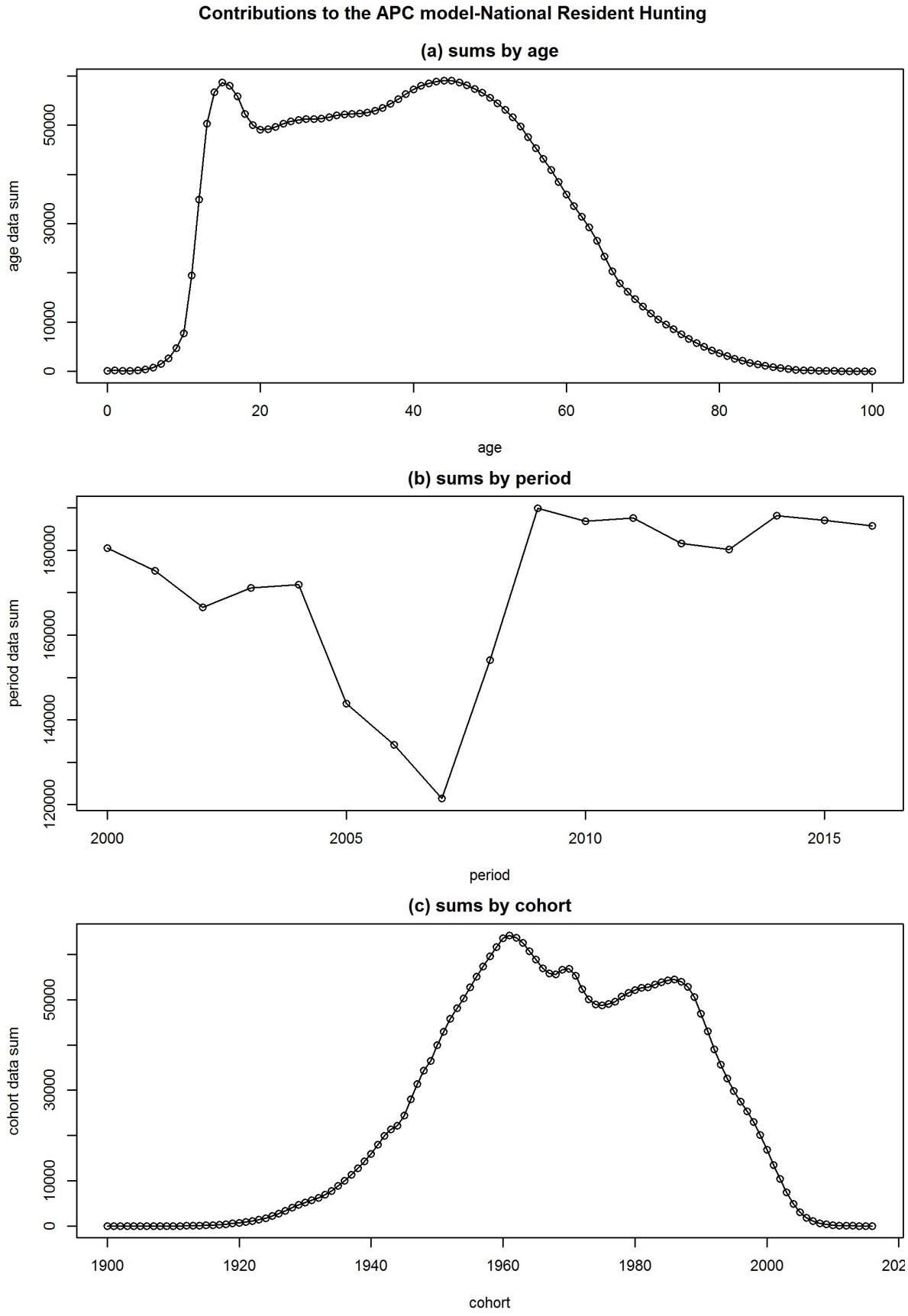
Ages included in this analysis include persons aged 0 to 100. There were a negligible amount of purchases from people over 100, but these were truncated to ease and standardize analysis. Lifetime licenses purchased for infants less than 1 year of age (age 0) are included in this study. The "(a)-sums by age" sections of the following graphs indicate there is an age effect for fishing (steeper decline as participants reach their late 60's), hunting (gradual decline starting when participants are in their early 60's), and for combination licenses (a decline starting when participants reach their 60's with a brief recovery at retirement age, and then a continued decline). This indicates that people tend to age out of fishing later in life than hunting. For resident hunting licenses,

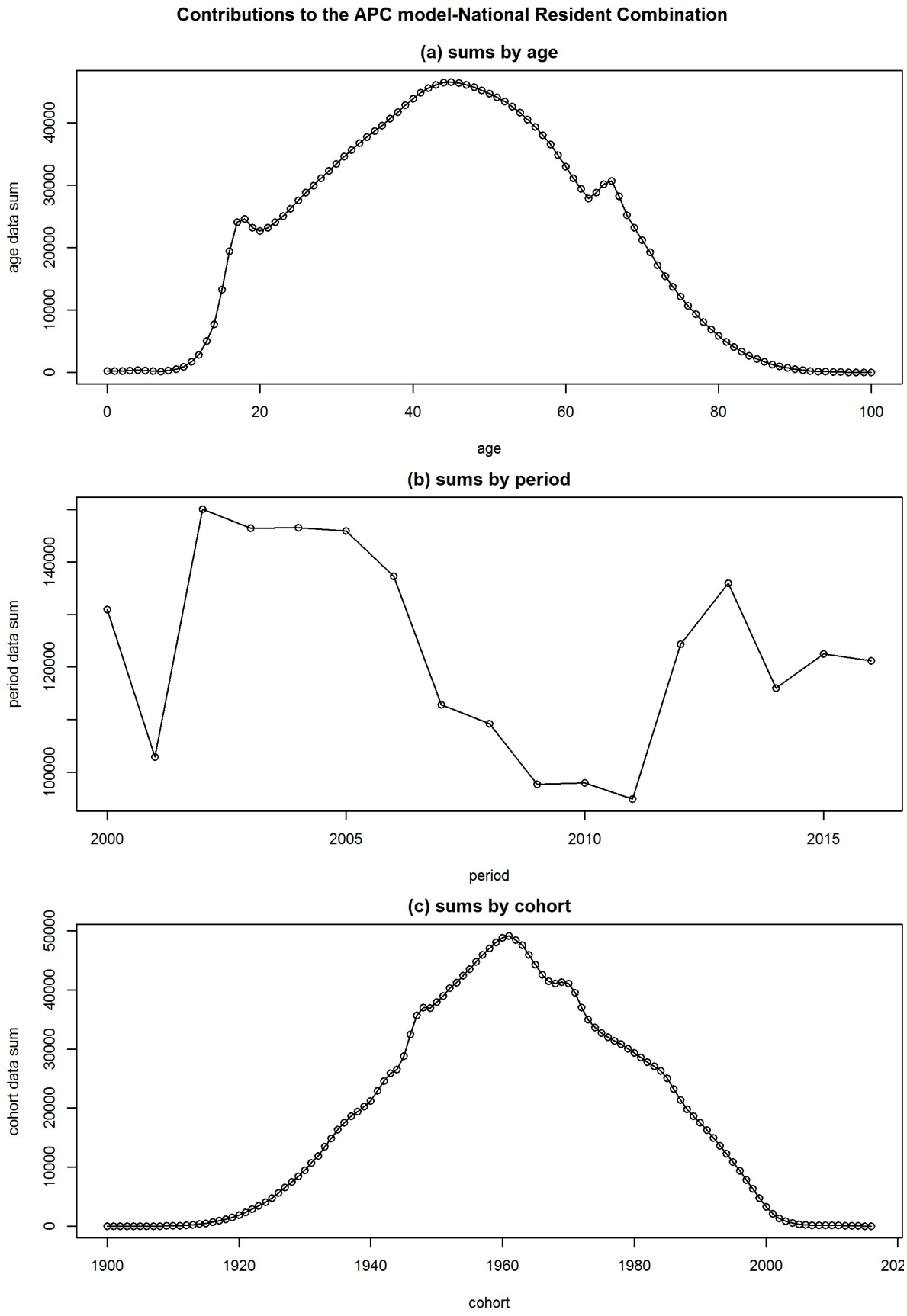
and, to a lesser extent, resident combination licenses, there is an age effect seen in the purchasing proclivities of the youth. The hunting license purchases indicate an age effect in the early-to-mid-teenage years, while the resident combination licenses undergo an age effect in the later teenage years. Nonresident hunting licenses see a muted uptick in sales to youth, but not in the same volume as the resident counterparts. There is small age effect in the nonresident combination license purchases in the childhood years. Both resident and NR combination license in the child years could be from parents purchasing their children combination licenses, but further investigation is necessary.

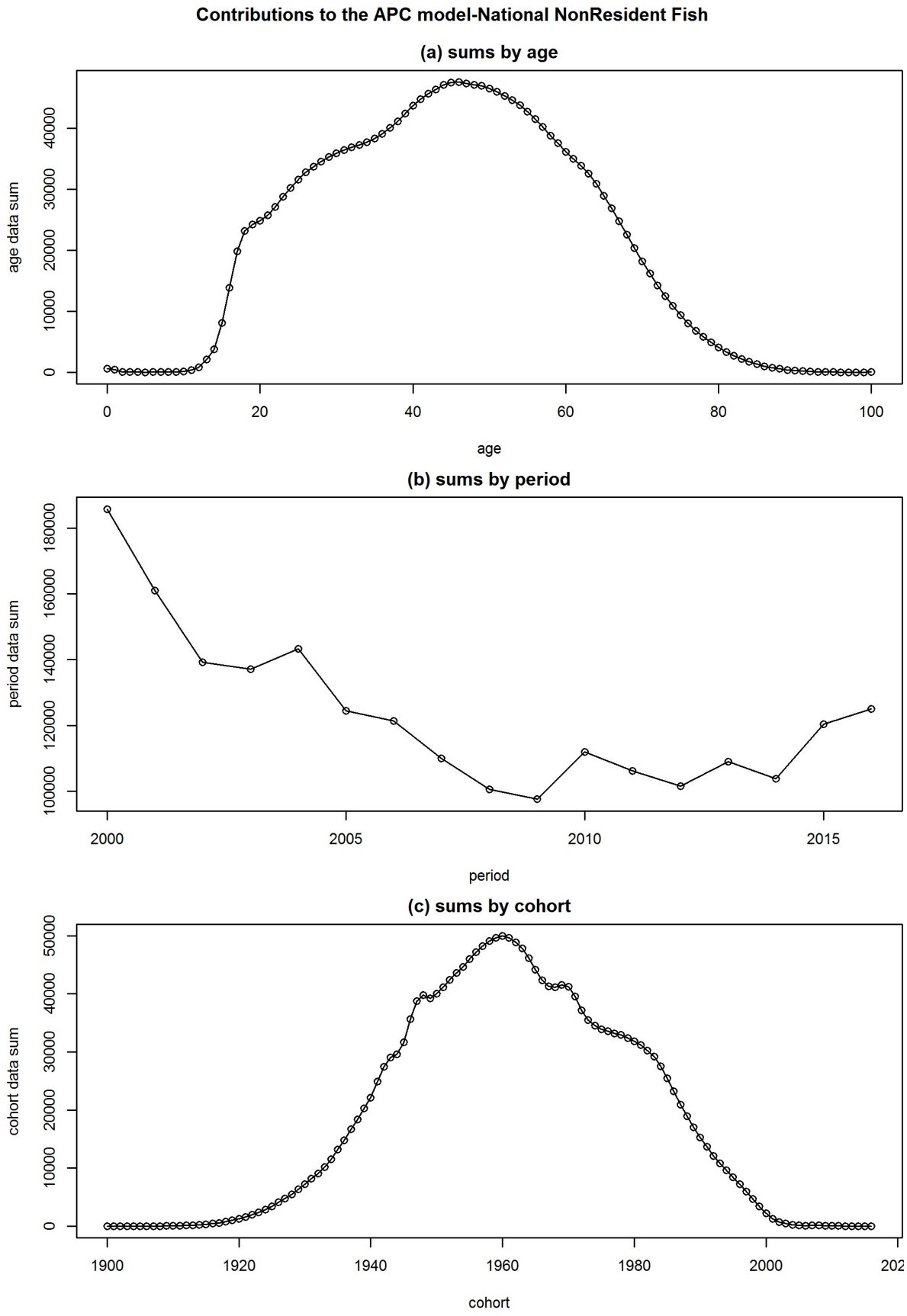
License data from the periods between 2000 to 2016 were included for the national-level data. Some states provided earlier data and that was included only in the state specific trends. Many states included 2017 data, but because the license year was incomplete, it was excluded for all states. The periods that are included in this study have influenced the different license groups in various ways. The section "(b)-sums by periods" show that both fishing and hunting were temporarily declined in 2007, though hunting was impacted to a more significant degree (on the fishing graph there is a slight "V"-shape, whereas on the hunting line there is a prominent "V"-shape). It appears that after a few years each activity returned to its prevailing trend, with fishing on an upward trend and hunting on a relatively flat trajectory. Combination licenses also experienced a decline in 2007, but the pattern was sustained for longer, namely until 2011, before combination license purchases began to return to normal. Nonresident fishing license purchases experienced a decline beginning earlier than resident licenses, bottoming-out in about 2009, but they still have not fully recovered to previous levels. Nonresident hunting license purchases strongly mirror the purchasing patterns associated with resident hunting licenses. Nonresident combination license purchases show a gradual increase across time; presumably this is due to states incentivizing the purchase of combination licenses over licenses that confer hunting-only or fishing-only privileges in an effort to obtain dual federal matching funds.

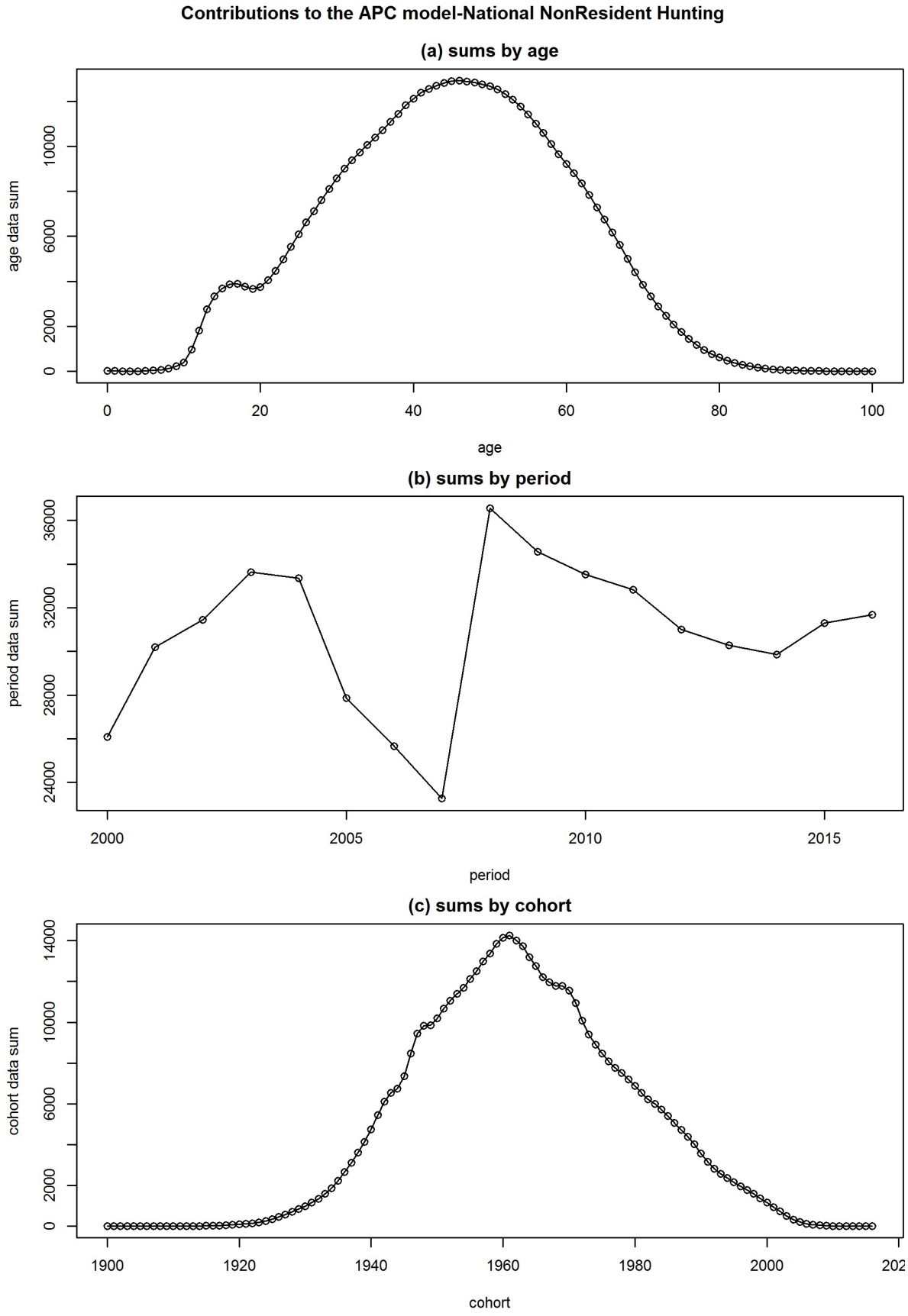
Cohorts contained in this analysis include those persons born between 1900 and 2016. The earliest cohort being the 100-year olds in the 2000 period (born in 1900), and the latest cohort being the 0-year olds in the 2016 period (born in 2016). There is a strong cohort peak for participants born near 1960 for all six license groupings (fishing, hunting, and combination licenses for both residents and nonresidents). This is readily manifested in the "(c)-sums by cohort" sections of the following graphs. Interestingly, for resident fishing and resident hunting, there is a much smaller cohort effect for individuals born in the years 1977 to 1983. Though this effect is not as pronounced as the 1960 cohort, the 1980 cohort may be a fertile area for recruitment, as these individuals are likely the offspring of the 1960's cohort and may have a latent demand for these activities. Therefore, outreach to individuals who are presently (as of 2017) in their late 30's may be a fruitful endeavor for recruitment or reactivation activities. Furthermore, agency investment into this age group will likely be magnified, as these new participants may recruit their children to hunting and angling.

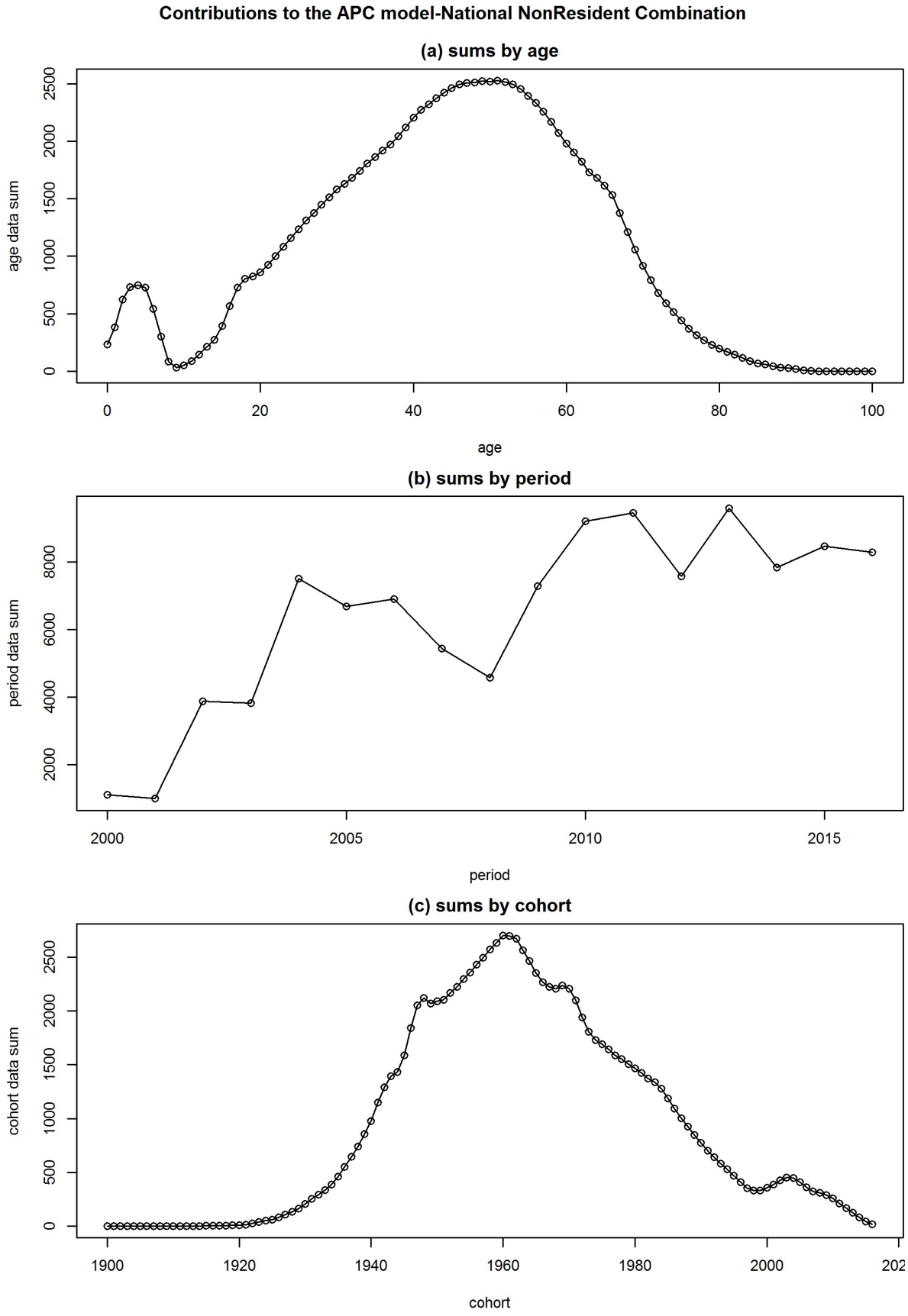

Contributions to the APC model-National Resident Fishing
(a) sums by age
age data sum
0e+00
4e+04
8e+04
0
20
40
60
80
100
age
(b) sums by period
period data sum
300000
350000
400000
2000
2005
2010
2015
period
(c) sums by cohort
cohort data sum
0
20000
60000
100000
1900
1920
1940
1960
1980
2000
cohort


Contributions to the APC model-National Resident Hunting
(a) sums by age
age data sum
0
10000
30000
50000
0
20
40
60
80
100
age
(b) sums by period
period data sum
120000
140000
160000
180000
2000
2005
2010
2015
period
(c) sums by cohort
cohort data sum
0
10000
30000
50000
1900
1920
1940
1960
1980
2000
202
cohort


Contributions to the APC model-National Resident Combination
(a) sums by age
age data sum
0
10000
20000
30000
40000
0
20
40
60
80
100
age
(b) sums by period
period data sum
100000
120000
140000
2000
2005
2010
2015
period
(c) sums by cohort
cohort data sum
0
10000
20000
30000
40000
50000
1900
1920
1940
1960
1980
2000
202
cohort


Contributions to the APC model-National NonResident Fish
(a) sums by age
age data sum
0
10000
20000
30000
40000
0
20
40
60
80
100
age
(b) sums by period
period data sum
100000
120000
140000
160000
180000
2000
2005
2010
2015
period
(c) sums by cohort
cohort data sum
0
10000
20000
30000
40000
50000
1900
1920
1940
1960
1980
2000
202
cohort


Contributions to the APC model-National NonResident Hunting
(a) sums by age
age data sum
0
2000
6000
10000
0
20
40
60
80
100
age
(b) sums by period
period data sum
24000
28000
32000
36000
2000
2005
2010
2015
period
(c) sums by cohort
cohort data sum
0
2000
6000
10000
14000
1900
1920
1940
1960
1980
2000
202
cohort


Contributions to the APC model-National NonResident Combination
(a) sums by age
age data sum
0
500
1000
1500
2000
2500
0
20
40
60
80
100
age
(b) sums by period
period data sum
2000
4000
6000
8000
2000
2005
2010
2015
period
(c) sums by cohort
cohort data sum
0
500
1000
1500
2000
2500
1900
1920
1940
1960
1980
2000
202
cohort

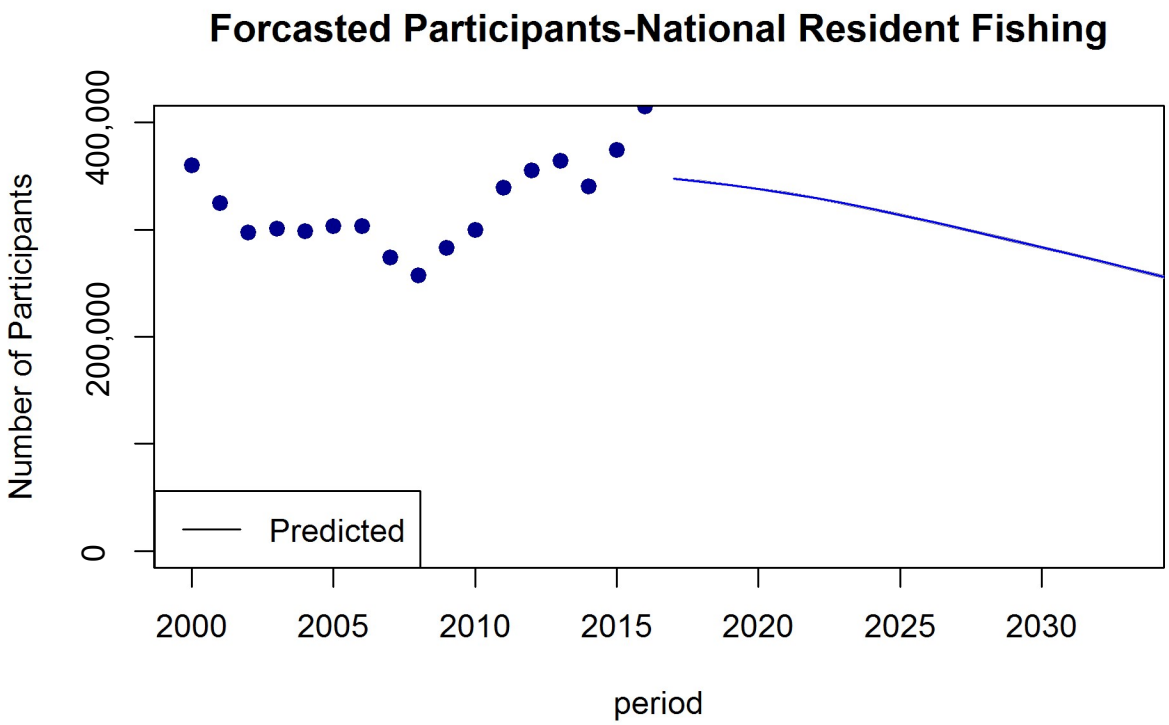
Predictive Models

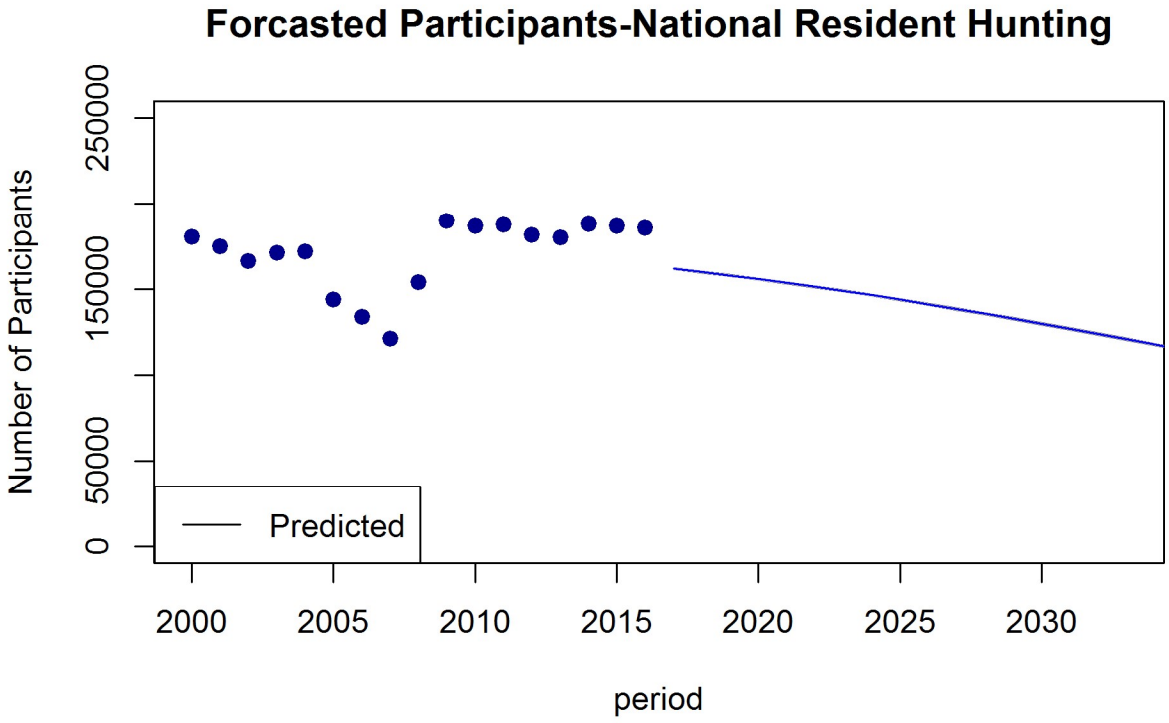
Predicting the volume of license sales is of paramount interest to state wildlife agencies, recreational-based industry, and conservation-oriented nongovernmental organizations. However, a weakness of simple regression or curvilinear extrapolations of sales trends is that only period effects are accounted for. The benefit of age-period-cohort analysis is that it accounts for the prevailing trend for the effects of age and the attrition of cohorts as they move through time. It important to note that these predictions become less precise the further the extrapolation into the future; these models cannot account for future period effects such as price changes, drought, or economic conditions. It is also important to remember the models used for these extrapolations consider the average volume of license sales (for the states that provided useable data for each respective year). This approach was used so the volume would not be disproportionately influenced by each state having data available for various years. An artifact of this approach is the Y-axes have volumes that are informative as to the relative percentages only. The APC model for nonresident combination licenses did not converge because the volume sold in each state was too low and may have varied significantly from year to year.

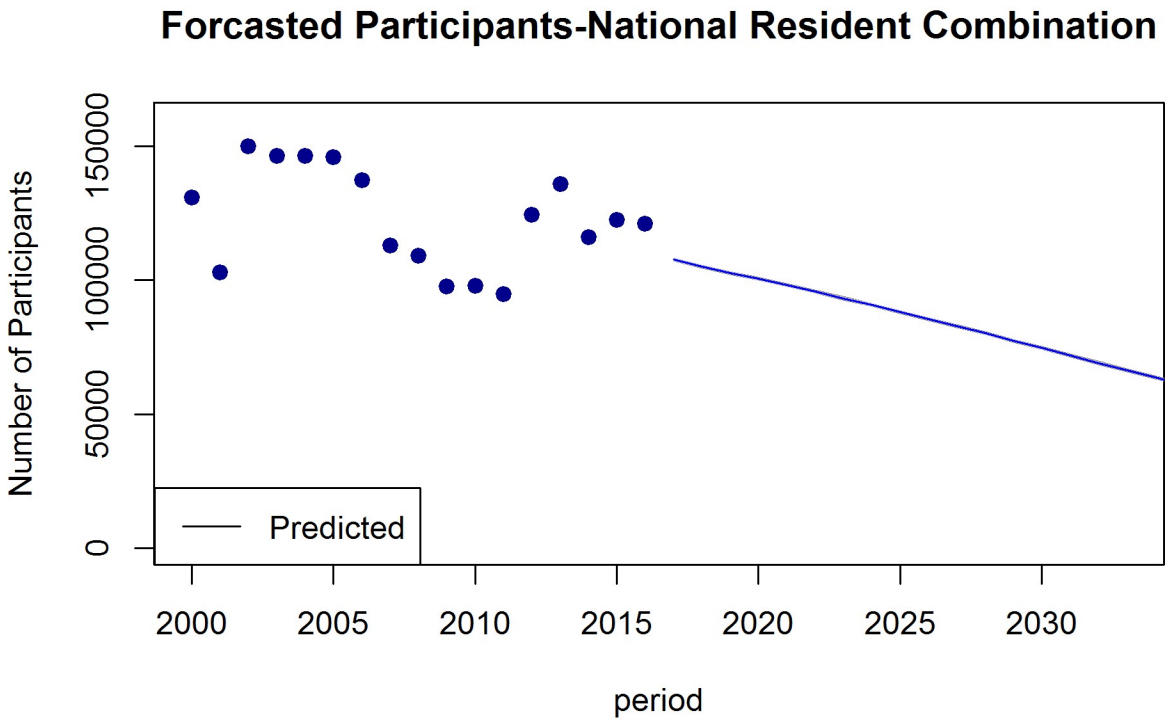
Despite these limitations, we were able to generate reasonable estimates for the license groups within this study. For example, in the year 2025, the conservation community can expect to see a 10%, 11% and 18% reduction in resident fishing, hunting, and combination license sales, respectively, when compared to 2017 as a baseline. Further, we might expect to see a decline of 29% for nonresident fishing and 10% for nonresident hunting for the 2017-2025 time period as well.

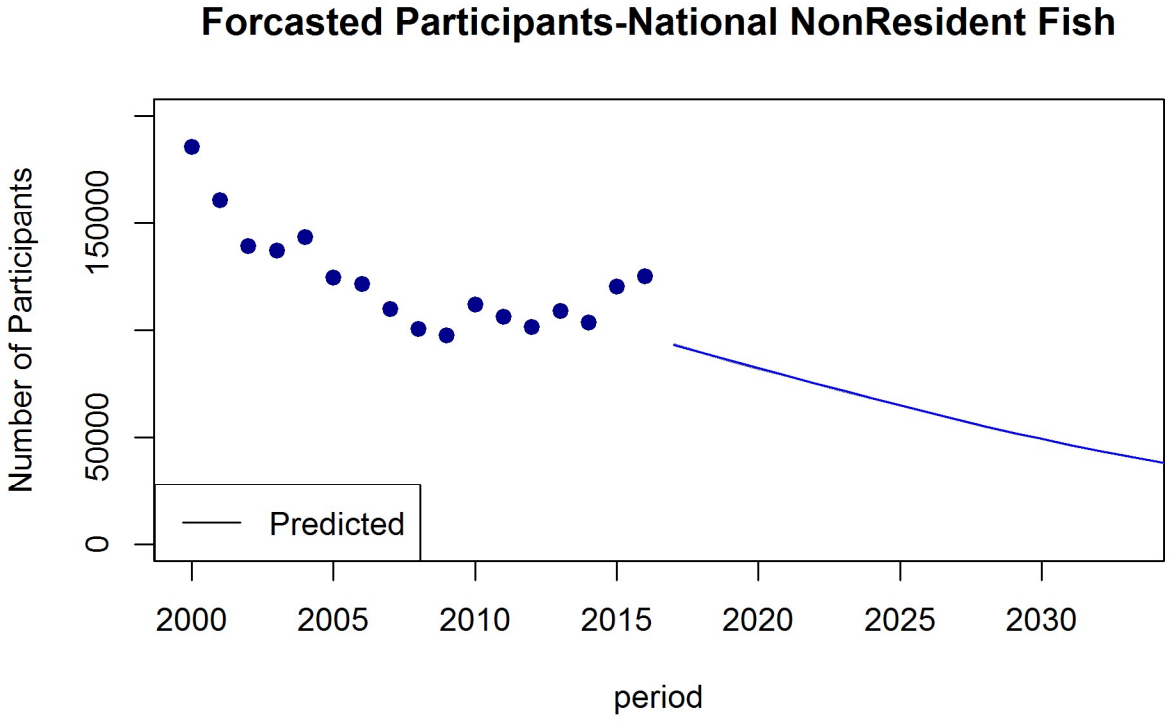
	Resident Fish	Resident Hunt	Resident Combination	NonResident Fish	NonResident Hunt
2018	-0.8%	-1.3%	-2.3%	-4.0%	-0.9%
2019	-1.6%	-2.6%	-4.5%	-7.9%	-1.8%
2020	-2.7%	-3.9%	-6.7%	-11.8%	-2.8%
2021	-3.8%	-5.2%	-8.9%	-15.6%	-3.9%
2022	-5.1%	-6.7%	-11.1%	-19.3%	-5.1%
2023	-6.5%	-8.1%	-13.4%	-23.0%	-6.5%
2024	-8.1%	-9.7%	-15.7%	-26.7%	-8.0%
2025	-9.7%	-11.3%	-18.1%	-30.3%	-9.7%

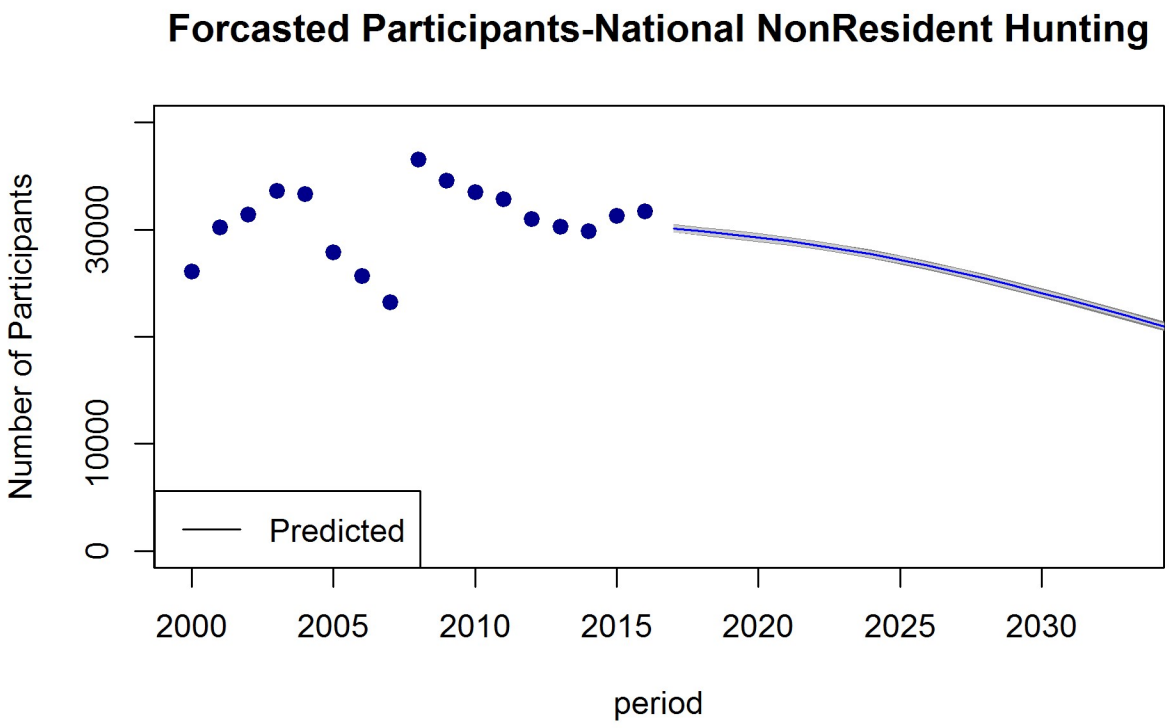
*As a percentage of 2017 baseline (estimated)

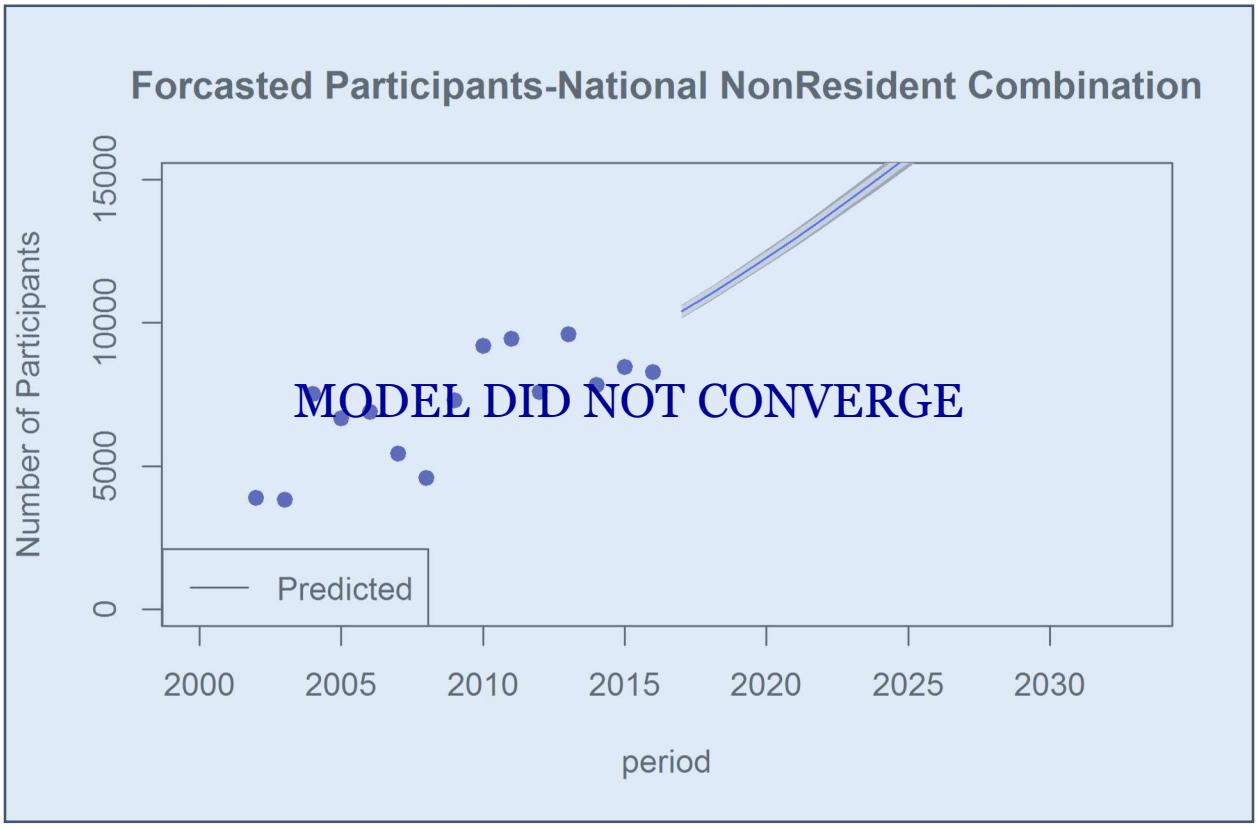

Forcasted Participants-National Resident Fishing
Number of Participants
0
200,000
400,000
Predicted
2000
2005
2010
2015
2020
2025
2030
period


Forcasted Participants-National Resident Hunting
Number of Participants
0
50000
150000
250000
Predicted
2000
2005
2010
2015
2020
2025
2030
period


Forcasted Participants-National Resident Combination
Number of Participants
0
50000
100000
150000
Predicted
2000
2005
2010
2015
2020
2025
2030
period


Forcasted Participants-National NonResident Fish
Number of Participants
0
50000
150000
Predicted
2000
2005
2010
2015
2020
2025
2030
period


Forcasted Participants-National NonResident Hunting
Number of Participants
0
10000
30000
Predicted
2000
2005
2010
2015
2020
2025
2030
period


Forcasted Participants-National NonResident Combination
Number of Participants
0
5000
10000
15000
MODEL DID NOT CONVERGE
Predicted
2000
2005
2010
2015
2020
2025
2030
period

CONCLUSION

These findings suggest that hunting and fishing are not middle-aged sports as previously thought. Rather, hunting and fishing is enjoyed by a cohort of individuals who just happen to be middle-aged presently. As time advances this group will continue to age, and will begin to be influenced by the age effect that is consistently seen when people reach their early 70's. This cohort of those more likely to hunt and fish is approximately 10 years on either side of the 1960 birth cohort. In approximately 2024 the lead edge of this group (those who are older) will begin to age out of hunting and fishing. By 2032 the peak of the cohort will be aging out of hunting and fishing. These estimations are similar with the findings from the 2012 study (2022, and 2036 respectively). The impact of this aging out will not be noticed by wildlife agencies at first, as license revenues will only be minimally impacted. However, if changes are not made, those interested in the future of hunting and angling will begin to witness the effects of these demographic influences in earnest by about 2032.

A casual observer may look at past sales patterns and see that some license sales are flat or even increasing slightly from year to year. However, year–to-year depictions do not account for the cohort of license buyers that is translating through the population, those who will lead to a predictable decline in sales. The age-period-cohort model is a more precise representation of the true nature of license sales as people leaving due to age and health issues will continue to concern the conservation community.

Fewer hunting and fishing license sales translate into threats to both wildlife and people. Wildlife conservation is largely funded through the discretionary spending of hunters and anglers through the direct sale of licenses and federal excise taxes on related sporting equipment. If participation diminishes, fewer funds will be allocated to conservation of the resource. Additionally, if participation in hunting and fishing lessens, there may be a weaker connection between the people of the United States and the land. Unfortunately, this will lead to a loss of the hunting and fishing heritage upon which this country grew.

Future research needs

All research leads to more research needs. In particular, this research would have benefited greatly from better data. Better data would yield a truer sense of the national population, rather than an aggregation of individual state license data. In particular, the ability to have a unique identifier to track people who hunt and/or fish in multiple states would be beneficial when conducting nation-wide research. In the current study, people hunting in multiple states are double counted. This is one of the reasons why the numbers reported herein are not congruent with USFWS's National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

Further analysis that ought to be considered is how churn, or the periodic entry and exit from hunting and angling, affect these patterns, and if churn is more related age factors,

period factors, or cohort factors. It would also be interesting to learn if these age-period-cohort patterns are congruent across genders or if some patterns influence males differently than females. Finally, this is a call for other researchers to develop a more sophisticated analysis to approach the interaction of fishing, hunting, and combination licenses. For example, there seems to be an initial trend of people gravitating toward combination licenses. This could be caused by societal trends moving toward participation in both, people buying the combination license to have the option to participate in both activities, or from agencies structuring their licenses to incentivize buying the combination licenses. Further research will need to be conducted to understand these issues.

Next steps

There are a few simple actions state wildlife agencies could take to generate more conservation funding. They include (in no particular order):

1. **Simplify Regulations**- Many states have begun to address the complexity of their license structure itself, but have stopped short of simplifying the regulations surrounding hunting and fishing. Over the years, agencies have, in good faith, altered regulations to provide maximum sustainable harvest. As a result, there are regulations that are complex and confusing to a newcomer to hunting and angling.
2. **Rigorous Evaluations of R3 Activities**- In the past, the conservation community has been somewhat permissive with R3 investments, allowing for lenient measures of success, such as outputs (the number of people attending camps). We recommend a more rigorous evaluation of where R3 dollars are being spent and a more stringent focus on actionable outcomes (did the event change a behavior in the attendee). Measuring outcomes is significantly harder than measuring outputs, but human dimensions specialists in respective states can formulate the research. Once this research is complete, the conservation community can reallocate R3 efforts into those activities that have the greatest impact.
3. **Research Latent Demand**- Human dimensions research should be conducted with the people that have an interest in hunting and fishing, but don't currently participate. Specifically, research should be conducted to understand what might motivate an individual to start these activities and what barriers are impeding them from starting.
4. **Benefit from Seniors**- Seniors hunt and fish in larger proportions than other age groups. States that have deeply discounted senior licenses will lose an increased amount of conservation revenue as the Baby Boomers continue to reach their senior years. As states continue to simplify their license structure, agencies should analyze the full ramifications of offering senior licenses, and consider working with constituents to phase out senior licenses (or reduce the discount provided). This step will be particularly import in the early 2030's, when there will be a greater amount of seniors who qualify for the license. More important than the revenue that seniors contribute through their license purchase is the political capital that this group can offer conservation. Work will need to be done to learn how to engage people in conservation after they are

unable to physically participate in the activities. This is particularly true when considering potential votes for hunting and fishing-friendly legislative actions.

5. **Focus on the Next Generation**- The next generation that is primed for recruitment is people in their late 30's. This cohort generally has value sets that are more congruent with hunting and fishing (Chase, 2013); which is manifested by a small peak moving through the license sales. This group has a higher latent demand for hunting and angling, has jobs that allow for vacation, and has disposable income. Once this group has a higher participation rate, they may begin to recruit their offspring (who are presently youth-aged).
6. **Scalable R3 Models**- Many R3 efforts are resource intensive, and state wildlife agencies and NGO partners invest a tremendous amount of time into these efforts. Many attendees enjoy their experience and are likely to continue on into the sports. However these efforts are not scalable, and therefore the efforts will always be limited by staff/volunteer time and monetary resources. Programs such as mentor incentives are more difficult to institute, but are very scalable, and should be implemented more frequently.
7. **Focus on Small Game**- Big game camps conducted by agencies and NGO's are tremendous. The draw rates are more generous, the harvest rates are higher, there are usually higher quality animals, and there are usually experienced hunters available to guide newcomers to the sport Frequently these camps also offer prizes, activities, and demonstrations. However, once new hunters no longer qualify for special hunts or events, the 'standard' hunting experience may not replicate those experienced in big game camps. This may lead to long-term dissatisfaction with hunting, as their experiences later in life do not match the expectations created in the big game camps. Instead, small game hunting offers many opportunities that big game hunting does not. Small game hunting can be done more frequently, is easier, and has a lower conscription threshold. It also allows for more than a single opportunity to harvest, so the importance of harvest diminishes, which allows for a broader definition of success. Finally, small game hunting does not artificially raise expectations.

Ultimately, funding conservation efforts on the backs of hunters, anglers, and shooters is not just or tenable. The conservation community will need to prepare to broaden their funding base. There are a number of states that have sought revenue from the general fund, so that all people benefiting from wildlife conservation, and the ecosystem services it provides, are paying into it. There are also a number of other efforts underway to obtain alternative conservation funds, including the introduction of the Recovering America's Wildlife Act.

These efforts to bolster conservation revenue, as well as efforts to understand current primary customers, are intended to safeguard wildlife well into the future. This research is a call to action to take the necessary steps to address the declines already seen, to increase hunting and fishing participation, to look for ways to broaden the conservation funding base, and to further the outdoor ethic in perpetuity.

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